

REMARKS:

AMENDMENTS TO THE CLAIMS

To expedite prosecution, claim 1 has been amended to recite "infiltrating the organic material into the spaces in the nanostructures by exposing the organic material to a solvent vapor."

- 5 Support for this feature can be found in original claim 12. As such, no new matter has been added. Furthermore, the Applicants submit that this amendment merely makes explicit that which was implicit in claim 1 as filed. As such, no limitation of claim 1 has been narrowed within the meaning of the decision in *Festo*. To further expedite prosecution, the Applicant has amended claim 11 as recommended by the Examiner. The Applicant submits that this
- 10 amendment merely corrects a minor typographical error. As such, the amendment merely makes explicit that which was implicit in claim 11 as filed. To further expedite prosecution, the Applicant has amended claims 10 and 19 to improve readability.

CLAIM OBJECTIONS

Claim 11 was objected to for an informality, which has been corrected as discussed above.

15 **CLAIM REJECTIONS**

35 USC 112

- Claims 10 and 19 were rejected under 35 USC 112, second paragraph as being indefinite. In rejecting the claims, the Examiner states that the phrases "e.g." and "and/or" separately render the claims indefinite because it is unclear whether the limitations following the phrase are part of
- 20 the claimed invention. In response, the Applicants direct the Examiner's attention to MPEP 2173.02, which states

- "The mere use of the phrase "such as" in the claim does not by itself render the claim indefinite. Office policy is not to employ *per se* rules to make technical rejections. Examples of claim language which have been held to be indefinite set forth in MPEP § 2173.05(d) are fact specific and should not be applied as *per*
- 25 *se* rules. The test for definiteness under 35 U.S.C. 112, second paragraph, is whether "those skilled in the art would understand what is claimed when the claim is read in light of the specification." *Orthokinetics, Inc. v. Safety Travel Chairs, Inc.*, 806 F.2d 1565, 1576, 1 USPQ2d 1081, 1088 (Fed. Cir. 1986)."

- Thus, if one skilled in the art is able to ascertain in the example above, the meaning of the terms preceding "e.g." in claims 10 and 19 in light of the specification, 35 U.S.C. 112, second
- 30 paragraph, is satisfied.

In the present case, claims 10 and 19 are Markush-type claims, which are by their very nature a listing of alternatives. The listing of examples within a Markush group merely specifies particular chemical that are within the group without necessarily excluding others that are not listed. Furthermore, in each claims 10 and 19, the phrase "e.g." is generally preceded by a well-defined class or category of chemical compounds. For example, at line 3 of claim 10, the phrase "e.g." is preceded by "poly(phenylene vinylene) and derivatives thereof". The Applicants submit that those of skill in the chemical arts will recognize what is meant by "poly(phenylene vinylene) and derivatives thereof".

Furthermore, the Applicant submits that MPEP 2173.05(d) is silent as to whether the phrase "and/or" renders a claim indefinite. The Applicants submit that the use of "and/or" is a well-known convenient notation understood to indicate that certain items can be used together or separately. Thus, those of skill in the art will be able to determine the scope of claims containing this phrase.

To expedite prosecution, the Applicants have amended lines 13-18 of claims 10 and 19 to improve readability. Furthermore, the Applicant submits that this amendment merely makes explicit that which was implicit in claims 10 and 19 as originally filed. As such, no new matter has been entered and no limitation of claims 10 and 19 has been narrowed within the meaning of the decision in *Festo*.

35 USC 102

Claims 1, 2, 5, 6, 7 and 9 were rejected under 35 USC 102(b) as being anticipated by Chemical Physics Letters 330, 2000 to Hagenmueller et al. (hereinafter Hagenmueller). In rejecting the claims the Examiner states that Hagenmueller teaches a method of infiltrating an organic material into and between carbon nanotubes comprising disposing the organic material proximate the nanostructures and exposing the organic material to a solvent vapor.

The Applicants respectfully traverse the rejections. Claim 1 has been amended to recite that exposing the organic material to the solvent vapor causes infiltration into the nanostructures. Hagenmueller, by contrast teaches dispersion of carbon nanotubes in a polymer and dynamically mixing the nanotubes by sonication in dimethylformamide (DMF) for three hours (see page 220, third full paragraph). After the sonication, the nanotube-DMF dispersion is mixed with a solution of PMMA and DMF dried, broken into pieces and hot pressed. Hagenmueller does not

specifically mention that the PMMA is exposed to the DMF vapor. Therefore, the Applicants conclude that the Examiner is asserting that the solvent vapor exposure is an inherent result of the evaporation of the solvent.

5 In order to rely on inherency, as the Examiner has done here, the Examiner must provide a rationale or evidence tending to show inherency (see MPEP 2112). The Examiner has not done so and has based his rejection on the assumption that evaporating a solvent from a polymer exposes the polymer to the solvent vapor. The fact that a certain result or characteristic may occur or be present in the prior art is not sufficient to establish the inherency of that result or characteristic (MPEP 2112(IV)). See also *In re Rijckaert*, 9 F.3d 1531, 1534, 28 USPQ2d 1955,
10 1957 (Fed. Cir. 1993). Furthermore, "In relying upon the theory of inherency, the examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art." *Ex parte Levy*, 17 USPQ2d 1461, 1464 (Bd. Pat. App. & Inter. 1990)". The Examiner has not shown that that evaporating the solvent (DMF) from the PMMA solution invariably results in
15 exposing the PMMA to the DMF vapor. As such, the Examiner has not established a prima facie case of inherency.

In addition, Hagenmueller makes no mention of exposure of the PMMA to the DMF vapor as being necessary to the infiltration of the PMMA into the nanotubes. Instead, Hagenmueller teaches sonication of the nanotube-PMMA-DMF mixture followed by a melt-mixing process. It
20 is not clear whether the sonication or the melting melt mixing infiltrates the PMMA into the nanotubes. However, if it is the sonication then the PMMA is not exposed to solvent vapor until after infiltration into the nanotubes. Alternatively, if the melt mixing infiltrates the PMMA into the nanotubes Hagenmueller does not teach that any solvent vapor is present during this process or that exposure to solvent vapor has anything to do with infiltrating the PMMA into the
25 nanotubes. Thus, Hagenmueller does not teach, and in fact teaches away from, infiltrating organic material into spaces in nanostructures "*by exposing the organic material to a solvent vapor*" as set forth in claim 1. As such, Hagenmueller does not teach all the features of and, therefore, does not anticipate claim 1. Thus, claim 1 defines an invention suitable for patent protection.

30 For the reasons set forth above, the applicants submit that Hagenmueller does not anticipate claim 1 that this independent claim defines an invention suitable for patent protection.

Furthermore dependent claims 2, 5, 6, 7 and 9 depend from claim 1 and recite additional features therefor. As such, and for the same reasons set forth above the Applicant submits that these dependent claims define an invention suitable for patent protection.

35 USC 103

5 Lahiff in view of Evans

Claims 1-3, 4, 5, and 9 have been rejected under 35 USC 103 as being obvious over Lahiff (Nano Letters 2003, Vol. 3, No. 10, pp. 1333-1337). in further view of US Patent Application Publication 20040010048 to Evans. The Examiner argues that Lahiff teaches infiltrating an organic polymer into spaces in nanostructures and that Evans teaches (at paragraph 21) that
10 solvent vapors penetrate and plasticize polymers without the addition of high heat.

The Applicant respectfully traverses the rejections. Lahiff teaches depositing poly-(dimethylsiloxane) PDMS onto a patterned array of carbon nanotubes. Lahiff states that the mixture migrates into vacant areas in the nanotube film (see p. 1333, third paragraph). Thus, Lahiff teaches that nothing further is necessary to infiltrate the PDMS. As such, there would be
15 no motivation at all to combine Lahiff with Evans. As such Lahiff and Evans are not properly combinable and a prima facie case of obviousness cannot properly be made regarding claims 1-3, 5 and 9. See *in re Gordon*, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984). Therefore, the applicant submits that claim 1, as it now stands, fully satisfies the requirements of 35 U.S.C. § 103 and is patentable thereunder.

20 Furthermore, although Evans teaches that gas or solvent can *plasticize* a polymer Evans is devoid of any teaching or suggestion that such plasticization would at all facilitate infiltration of organic materials (such as polymers) into nanostructures.

The definition of plasticizing a polymer is “decreasing the glass transition temperature (T_g) of a polymeric material, generally to a point below room temperature so that plastics that are initially
25 hard, rigid, and brittle become soft, flexible, and impact resistant” (see in the accompanying IDS: <http://www.ctsmachinery.com.au/glossary.asp?letter=p&page=6>). The definition of plasticizing a polymer does not include any reference whatsoever to infiltration of a nanostructure or more generally material transport.

However, in contrast to the Examiner’s assertion that solvent vapors penetrate and plasticize
30 polymers without the addition of high heat, Evans does not teach or suggest that plasticizing will

facilitate infiltration any polymer into any nanostructure. Indeed, Evans makes no mention of any transport property whatsoever. By definition, plasticizing is NOT equivalent to infiltration. Further, the word “infiltrate” only appears once in the Evans application, and only in the context is of (human or animal) cells infiltrating an implant, which is entirely unrelated to polymers infiltrating a nanostructure.

The Examiner has pointed to no teaching in Evans or any other cited reference tending to show that plasticization, i.e., reduction in the glass transition temperature, would facilitate infiltration. Therefore, the Examiner has not established a prima facie case of obviousness since obviousness cannot be established absent some teaching, suggestion or incentive supporting the combination (ACS Hospital Systems, Inc. v. Montefiore Hospital, 732 F. 2d 1572, 1577, 221 USPQ 929, 933 (Fed. Cir. 1984)). Absent such a showing in the prior art, the Examiner has impermissibly used the applicants teaching to hunt through the prior art for the claimed elements and combine them as claimed (see In re Vaeck, 947 F. 2d 488, 20 USPQ 2d 1438 (Fed. Cir. 1991); In re Bond, 910 F. 2d 831, 15 USPQ 2d 1566 (Fed. Cir. 1990); In re Laskowski, 871 F. 2d 115, 117, 10 USPQ 2d 1397, 1398 (Fed. Cir. 1989)). The use of hindsight is never permissible to establish obviousness.

Furthermore, the Applicants submit that reducing the glass transition temperature, as taught by Evans, would not cause infiltration of a polymer into nanostructures. However, a recent paper by Nobel laureate Alan Heeger directly contradicts the Examiner’s assertion. Specifically, Glenn Bartholomew and Alan J. Heeger in “Infiltration of Regioregular Poly[2,2’-(3hexylthiophene)] into Random Nanocrystalline TiO₂ Networks”, Adv. Funct. Mater., Vol. 15, No. 4., April, 2005, state that “...This suggests that the melting point, rather than the glass transition temperature, is the phase transition of real importance for incorporating the polymer”. See page 679, second full paragraph. In other words, a Nobel Laurate in Polymer Chemistry states in a 2005 publication that plasticizing the polymer does not lead to its incorporation in nanopores. As such, no combination of Lahiff with Evans teaches incorporation of organic material into nanostructures by exposure to solvent vapor as set forth in claim 1 and a prima facie case of obviousness is not present. Furthermore, the teachings of Heeger strongly suggest that plasticization with solvent vapor as taught by Evans for the purpose of improving infiltration is counterintuitive. The fact that such as been shown to work (see page 4, lines 1-6 of the present application) is, therefore, a surprising result and a strong secondary indicia of unobviousness.

Thus for the reasons set forth above, the Applicants submit that claims 1-3, 4, 5 and 9 define an invention suitable for patent protection.

McCarthy in View of Evans

Claims 6-10 and 11 were rejected under 35 USC 103 as being obvious over McCarthy (Synthetic Metals 121 (2001) 1225-1226) in view of Evans. The Examiner argues that McCarthy teaches infiltrating a polymer inside and between carbon nanotubes and that Evans teaches using solvent vapors to penetrate and plasticize polymers as described above.

The Applicants respectfully traverse the rejections. McCarthy is similar to Hagenmueller in teaching incorporation of polymer into nanotubes by mixing them together in a solution and then sonicating (see p. 1225, first full paragraph). Thus, as with Lahiff there would be no motivation to combine McCarthy with Evans since the nanotubes are already incorporated without plasticization. Furthermore, as discussed above, leading researchers believed that reduction of glass transition temperature (i.e., plasticization as taught by Evans) was not likely to lead to infiltration of nanostructures. Thus for the reasons set forth above, the Applicants submit that claims 6, 10 and 11 define an invention suitable for patent protection.

Lahiff in View of Evans and Bower

Claims 12-14, 18 and 20 as being obvious over Lahiff in view of Evans and US Patent 6,630,772 to Bower. The Examiner's combination of Lahiff and Evans is as described above. The Examiner further alleges that Bower teaches forming an electrode adjacent to the carbon nanotube film.

The Applicants respectfully traverse the rejections. As discussed above, the Applicant submits that claim 12 is distinguishable over the combination of Lahiff and Evans as discussed above with respect to claim 1. Claims 13-14, 18 and 20 depend, either directly or indirectly, from claim 12 and recite additional features therefor. The Examiner has pointed to no teaching in Bowers indicating that solvent vapor exposure is likely to lead to infiltration of organic materials into nanostructures as set forth in claim 12. Therefore, no combination of Lahiff, Evans and Bower teaches all the features of claims 12-14, 18 and 20. Thus for the reasons set forth above, the Applicants submit that claims 12-14, 18 and 20 define an invention suitable for patent protection.

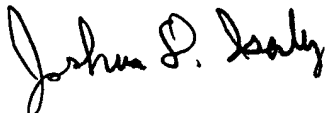
McCarthy in View of Evans and Bower

Claims 15-17 and 19 were rejected as being obvious over McCarthy in view of Evans and Bower. The Examiner's combination of McCarthy and Evans is as described above. The Examiner alleges that Bower teaches forming an electrode adjacent to the carbon nanotube film. The Applicants respectfully traverse the rejections. As discussed above, the Applicant submits
5 that claim 12 is distinguishable over the combination of McCarthy and Evans as discussed above. Claims 15-17 and 19 depend, either directly or indirectly, from claim 12 and recite additional features therefor. The Examiner has pointed to no teaching in Bowers indicating that solvent vapor exposure is likely to lead to infiltration of organic materials into nanostructures as set forth in claim 12. Therefore, no combination of McCarthy, Evans and Bower teaches all the
10 features of claims 15-17 and 19. Thus for the reasons set forth above, the Applicants submit that claims 12-15-17 and 19 define an invention suitable for patent protection.

CONCLUSION

For the reasons set forth above, the Applicants submit that all claims are allowable over the cited
15 art and define an invention suitable for patent protection. The Applicants therefore respectfully request that the Examiner enter the amendment, reconsider the application, and issue a Notice of Allowance in the next Office Action.

Respectfully submitted,

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